

PATENT APPLICATION  
of  
THOMAS H. LOHR  
for  
DRIVER PULLEY SYSTEM FOR USE IN TORQUE CONVERTER

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## DRIVER PULLEY SYSTEM FOR USE IN TORQUE CONVERTER

## BACKGROUND

The present disclosure relates to torque converters. More particularly, the present disclosure relates to driver pulley systems for use in torque converters.

5           Torque converters are used on vehicles as a type of transmission between an engine of the vehicle and a wheel (or other ground-engaging element) of the vehicle. A torque converter is variable in that it can upshift and downshift in response to engine speed (i.e., engine rpm) and torque (i.e., rotational resistance) encountered by the wheel. Such torque occurs, for example, when the vehicle travels  
10 up a hill.

A torque converter typically includes a belt trained about a driver pulley system and a driven pulley system. The driver and driven pulley systems are adjustable in response to engine speed and torque to vary the drive ratio of the torque converter.

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## SUMMARY

According to the present disclosure, a driver pulley system is disclosed for use in a torque converter. The driver pulley system includes a torque transmission device configured to transmit torque between components of the driver pulley system  
20 through a path not including a centrifugal weight unit included in the driver pulley system to limit loading on the centrifugal weight unit.

The driver pulley system includes a fixed unit and a movable unit. The fixed unit is adapted to be fixed to a rotatable output of an engine to rotate with the engine output. The movable unit is configured to move relative to the fixed unit to  
25 facilitate shifting of the torque converter. A fixed flange included in the fixed unit and a movable flange included in the movable unit cooperate to receive a belt included in the torque converter. The centrifugal weight unit is responsive to centrifugal force to move the movable flange toward the fixed flange to upshift the torque converter upon increased engine speed.

30           The torque transmission device is included in the movable unit and is configured to transmit torque from the movable flange to a cover that is included in the fixed unit and axially covers the centrifugal weight unit. The torque transmission

device includes a movable sleeve, a slider mount, and a slider. The movable sleeve is coupled to the movable flange for axial movement with the movable flange. The slider mount is coupled to an outer surface of the movable sleeve. The slider is coupled to the slider mount for axial, slidable movement against a drive plate included in the cover to transmit torque to the drive plate upon downshifting of the engine.

Additional features of the present disclosure will become apparent to those skilled in the art upon consideration of the following detailed description exemplifying the best mode of the disclosure as presently perceived.

## 10 BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description particularly refers to the accompanying figures in which:

Fig. 1 is a perspective view of a vehicle (e.g., a go-kart) showing the vehicle including a torque converter that is continuously variable in response to vehicle engine speed and torque (i.e., rotational resistance) experienced by one or both of the vehicle rear wheels and showing the torque converter including a belt trained about a driver pulley system coupled to the vehicle engine and a driven pulley system coupled to one or both of the rear wheels;

Fig. 2 is a diagrammatic view of the torque converter showing the driver pulley system including (1) a fixed unit configured to be fixed to an output of an engine for rotation with the engine output and (2) a movable unit that is configured to move relative to the fixed unit to facilitate shifting of the torque converter and that includes a torque transmission device configured to transmit torque to the fixed unit through a path not including a centrifugal weight unit of the driver pulley system upon application of torque to one or both of the rear wheels;

Fig. 3 is an exploded perspective view of the driver pulley system showing components of the movable unit and components of the centrifugal weight unit positioned between components of the fixed unit;

Fig. 4 is a front elevation view of the driver pulley system, with portions broken away, showing components of the torque transmission device including a somewhat T-shaped slider positioned for slidable movement against a somewhat U-shaped drive plate of the fixed unit;

Fig. 5 is a sectional view taken along lines 5-5 of Fig. 4 showing the driver pulley system at rest in which the belt is positioned at its radially innermost position to position a movable flange of the movable unit away from a fixed flange of the fixed unit;

5                    Fig. 6 is a sectional view taken along lines 6-6 of Fig. 5 showing the torque transmission device including a slider mount coupled to an outer surface of a sleeve and a slider coupled to the slider mount and engaging a drive plate included in a cover of the fixed unit;

10                   Fig. 7 is an elevation view showing the vehicle traveling on a level surface;

                    Fig. 8 is a sectional view of the driver pulley system corresponding to the situation shown in Fig. 7 in which the centrifugal weight unit has moved radially outwardly to cause the movable flange to move axially toward the fixed flange and the belt to move radially outwardly to upshift the torque converter due to an increase  
15                   in engine speed;

                    Fig. 9 is an elevation view showing the vehicle traveling up a hill; and

                    Fig. 10 is a sectional view of the driver pulley system corresponding to the situation shown in Fig. 9 in which torque applied to one or both of the wheels due to travel up the hill results in downshifting of the torque converter and application of  
20                   torque to the movable flange by the belt for transmission to the cover through components of the torque transmission device but not through the centrifugal weight unit to limit loading on the centrifugal weight unit.

#### DETAILED DESCRIPTION

25                   A torque converter 10 for use in a vehicle 12 is shown, for example, in Fig. 1. Torque converter 10 includes a driver pulley system 14, a driven pulley system 16, and a belt 18 trained about driver and driven pulley systems 14, 16. Driver pulley system 14 includes a centrifugal weight unit 20 and a torque transmission device 22 configured to transmit torque between components of driver pulley system  
30                   14 through a path not including centrifugal weight unit 20 to limit loading thereon, as suggested diagrammatically in Fig. 2.

                    Torque converter 10 is continuously variable in response to speed of an engine 24 of vehicle 12 and torque experienced by a ground-engaging device 26 of

vehicle 12. Driver and driven pulley systems 14, 16 are adjustable in response to engine speed and torque to vary the “drive ratio” of torque converter 10.

In the illustrated embodiment, vehicle 10 is a go-kart and ground-engaging device 26 is one or both of the rear wheels of the go-kart, as shown, for example, in Fig. 1. A connector 28 is used to interconnect driven pulley system 18 and device 26. Connector 28 includes a jackshaft 30 coupled to driven pulley system 16, a rear axle 32 coupled to device 26, and a chain-and-sprocket unit 34 coupled to jackshaft 30 and rear axle 32. In some embodiments, a differential (not shown) is included in connector 28. It is within the scope of this disclosure for vehicle 10 to be other types of vehicles such as all-terrain vehicles, motorcycles, mini-bikes, and snowmobiles, and the like, and for ground-engaging element 26 and connector 28 to be suitable for such a vehicle.

Driver pulley system 14 includes a fixed unit 36 and a movable unit 38, as shown, for example, in Figs. 2 and 3. Fixed unit 36 is adapted to be fixed to a rotatable engine output 40 for rotation therewith. Engine output 40 is, for example, a drive shaft of engine 24, as shown, for example, in Figs. 5, 8, and 10. Movable unit 38 is configured for axial movement relative to fixed unit 36 along an axis 39 to facilitate shifting of the drive ratio of torque converter 10.

In the illustrated embodiment, fixed unit 36 includes a fixed sleeve 42, a drive nut 44, a fastener 46, a cover 48, and an annular fixed flange 50, as shown, for example, in Figs. 3, 5, 8, and 10. Fixed sleeve 42 is adapted to receive and be keyed to engine output 40. Drive nut 44 is coupled to engine output 40 by fastener 46. Cover 48 is coupled to drive nut 44 by, for example, welding. Together, sleeve 42, drive nut 44, and fastener provide a hub of fixed unit 36. Fixed flange 50 is coupled to sleeve 42 by, for example, welding and extends radially outwardly therefrom.

In the illustrated embodiment, movable unit 38 includes an annular movable flange 52 and torque transmission device 22, as shown, for example, in Figs. 3, 5, 8, and 10. Movable flange 52 and fixed flange 50 cooperate to receive belt 18 therebetween for engagement therewith. Centrifugal weight unit 20 is positioned between movable flange 52 and cover 48 and radially outwardly from torque transmission device 22.

In the illustrated embodiment, torque transmission device 22 includes a movable sleeve 54, three slider mounts 56, and a slider 58 coupled to each slider

mount 56, as shown, for example, in Figs 3, 4, 5, 8, and 10. Movable flange 52 is coupled to a first end portion 60 of movable sleeve 54 by, for example, welding. Movable sleeve 54 is mounted on a pair of bearings 62 positioned between movable sleeve 54 and fixed sleeve 42 to allow axial movement of movable flange 52 relative to fixed flange 50. A spring 64 is positioned between bearings 62 to move movable sleeve 54 and, thus, movable flange 42 away from fixed flange 50.

Slider mounts 56 are coupled to an outer surface 65 of movable sleeve 54 at a second end portion 66 of movable sleeve 54, as shown, for example, in Figs. 3, 5, 8, and 10. Slider mounts 56 are positioned about 120° apart from one another and are configured as axially elongated blocks.

Each slider 58 includes a collar 68 and a pair of slider tabs 70, as shown, for example, in Figs. 3, 4, and 6. Collar 68 is axially elongated so as to fit on one of slider mounts 56. Collar 68 includes a pair of parallel, axially elongated side walls 72 and a pair of parallel end walls 74 coupled to and extending between side walls 72. Each slider tab 70 is cantilevered to a side wall 72 so as to extend laterally outwardly therefrom. Collar 68 and slider tabs 70 cooperate so that slider 58 has an end profile that is T-shaped, as shown, for example, in Fig. 4.

Cover 48 includes a base plate 76 and a drive plate 78 associated with each slider 58 to rotate movable unit 38, as shown, for example, in Fig. 3. Base plate 76 is coupled to drive nut 44 by, for example, welding. Each drive plate 78 is coupled to base plate 76 by, for example, weldments 80 shown, for example, in Fig. 6. Drive plate 78 is U-shaped in cross-section and includes a drive plate tab mount 82 coupled to base plate 76 by weldments 80 and a pair of parallel, axially elongated drive plate tabs 84 extending radially from drive plate tab mount 82 to receive a collar 68 therebetween.

Each slider 58 is configured to slide against one of drive plates 78 upon axial movement of movable unit 38 relative to fixed unit 36. Each slider side wall 72 is configured to slide against an inner surface 86 of a drive plate tab 84. Engagement between side walls 72 and drive plate tabs 84 promote transmission of a drive force generated by engine 24 from fixed unit 36 to movable unit 38 and promote transmission of torque from movable unit 38 to fixed unit 36 as discussed in more detail herein. An edge 88 of each drive plate tab 84 engages a slider tab 70 to block radially outward movement of slider 58.

Sliders 58 are made of a relatively low friction material to facilitate slidable movement against drive plates 78. In the illustrated embodiment, sliders 58 are made of an acetal resin such as DELRIN®. In some embodiments, sliders 58 are made of materials such as polyethylene, powdered metal, or brass. A suitable  
5 coefficient of friction for the material of sliders 58 is about 0.18.

Components of driver pulley system 14 assume an at-rest/idle position shown, for example, in Fig. 5 when engine 24 is at rest or idling as indicated by a tachometer 90. In the at-rest/idle position, movable flange 52 is positioned at its farthest point away from fixed flange 50 to allow belt 18 to assume its radially  
10 innermost position on driver pulley system 14.

When engine speed increases, as suggested, for example, in Figs. 7 and 8, components of driver pulley system 14 assume an operational position shown, for example, in Fig. 8. Drive plates 78 rotate movable unit 38 through engagement between drive plate tabs 84 and side walls 72 of collars 68. Such rotation is  
15 transmitted to centrifugal weight unit 20 through weight guides 92 which are coupled to movable flange 52 and engage components of unit 20. In some embodiments, weight guides 92 are coupled to base plate 76 instead of movable flange 52.

Centrifugal weight unit 20 moves radially outwardly due to centrifugal force thereon upon increased engine speed. In the illustrated embodiment, unit 20  
20 includes three weights 94, three springs 96, and three spring connectors 98. Each spring connector 98 extends through a weight 94 to interconnect adjacent springs 96.

Weights 94 move radially outwardly and follow weight guides 92 when the centrifugal force on weights 94 overcomes a resistive force from springs 96. Radially outward movement of weights 94 causes axial movement of movable flange  
25 52 toward fixed flange 50. Movable flange 52 engages belt 18 to cause belt 18 to move radially outward to upshift torque converter 10. As movable flange 52 moves axially toward fixed flange 50, sliders 58 slide axially against drive plates 78.

Torque experienced by one or both wheels 26 causes torque converter 10 to downshift to maintain engine speed at about the level it was before vehicle 12  
30 began traveling up hill 100. Such torque may result from driving vehicle 12 up a hill 100 or other incline, as shown, for example, in Fig. 9.

As wheels 26 experience torque, driven pulley system 16 pulls belt 18 radially inwardly and applies torque to belt 18. Radially inward movement of belt 18

causes movable flange 52 to move axially away from fixed flange 50, as shown, for example, in Fig. 10. Such axial movement of movable flange 52 causes centrifugal weight unit 20 to move radially inwardly and causes sliders 58 to slide against drive plates 78.

5                   Torque applied to belt 18 is transmitted to movable flange 52 through engagement between belt 18 and movable flange 52. Torque transmission device 22 then transmits the torque from movable flange 52 to drive plates 78 for eventual transmission to drive shaft 40, thereby counteracting a tendency of engine speed to increase upon radially inward movement of weight unit 20.

10                  Device 22 transmits torque from movable flange 52 to cover 48 through a path not including weight unit 20 to limit loading thereon. Torque is transmitted from movable flange 52 in series through movable sleeve 54, slider mounts 56, and sliders 58 to drive plates 78. Side walls 72 of sliders 58 transmit torque to drive plate tabs 84 of drive plates 78. Device 22 thus provides means for  
15                  transmitting torque from movable flange 52 to cover 48 through a path not including centrifugal weight unit 20 for transmission of torque to engine output 40 upon application of torque to movable flange 52 by the belt 18.

                  Driver pulley system 14 moves to its at-rest/idle position when engine  
24 is turned off or engine 24 resumes idle. Spring 64 moves torque transmission  
20                  device 22 and movable flange 52 away from fixed flange 50 and springs 96 move weights 94 radially inwardly. Driven pulley system 16 pulls belt 18 back to its radially innermost position.